Prime and Composite

Standard I:	
Students will acquire number sense and perform operations with rational numbers.	
Objective 1:	
Represent whole numbers and decimals in a variety of ways.	
Intended Learning Outcomes:	
1. Demonstrate a positive learning attitude toward mathematics.	
2. Become mathematical problem solvers.	
3. Reason mathematically.	
Content Connections:	
Social Studies IV-2	

Background Information

Students learned to classify whole numbers from 2 to 20 as composite or prime, and 0 and 1 as neither prime nor composite, in fifth grade.

Every whole number greater than 1 is either a prime or composite number. A *prime* number has *exactly* two factors, 1 and itself. A *composite* number has more than two factors.

Commutative property is the fact that changing the order of addends or factors does not change the sum or product (e.g., 4 x 7 = 28 and 7 x 4 = 28).

Rules of divisibility

– A whole number is divisible by 2 if and only if the ones digit is even.

– A whole number is divisible by 3 if and only if the sum of its digits is divisible by 3.

– A whole number is divisible by 5 if and only if the ones digit is 5 or 0.

– A whole number is divisible by 6 if and only if it is divisible by 2 and 3.

– A whole number is divisible by 9 if and only if the sum of its digits are divisible by 9 (or 3).

– A whole number is divisible by 10 if and only if the ones digit is 0.

Research Basis

Hatfield, M., Edwards, N., Bitter, G. & Morrow, J. (2000). *Mathematics Methods for Elementary and Middle School Teachers*. New York, New York. John Wiley & Sons Inc.

"An activity-based approach to teaching with an emphasis on using manipulatives to build conceptual understanding! This valuable book combines practical teaching ideas, video examples, updated assessment techniques, and the NCTM Assessment Standards to give teachers all the background they need to introduce elementary and middle school students to the wonders of mathematics. Provides training and practicing teachers of kindergarten to the eight grade with ideas, techniques, and approaches to teaching mathematics such that their students will be prepared for later study."

Assessment Suggestions

- Observation of students, class discussion, and discovery.
- The *Prove or Disprove* worksheet may be used as an assessment tool.

Invitation to Learn

Pass out 12 centimeter cubes to each student. Have students make different shapes with the cubes. Share examples and point out examples and nonexamples of arrays. Write a definition of "array" as a class.
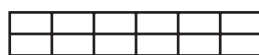
Instructional Procedures

Day 1

1. Use the *Manipulative Master* to create an array for numbers from 3 to 20. For example, say to the class, "Using your manipulatives, show me what 4 looks like. How many ways can you make a complete rectangle using only four squares?"

2. Continue through all numbers, 3-20.

3. Transfer arrays onto graph paper and label each rectangle.

   Example:
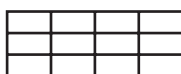
   3 x 4 = 12   2 x 6 = 12

Materials

For class:
- ❏ *We are Prime/ Composite Numbers* posters
- ❏ Sieve (or picture of)

For each student:
- ❏ Graph paper
- ❏ *Manipulative Master* or manipulatives
- ❏ *Sieve of Eratosthenes* worksheet
- ❏ *Prove or Disprove* worksheet
- ❏ Colored pencils

4. Circle each factor using one color. Put a circle around each product using a different color.

    Example:

    $$\text{③} \times \text{④} = \text{⑫} \qquad \text{②} \times \text{⑥} = \text{⑫}$$

5. Point out the commutative property—the fact that changing the order of addends or factors does not change the sum or product. *Example:*

    3 x 4 = 12 and 4 x 3 = 12

    factors 1, 2, 3, 4, 6, 12

6. Connect two factors using a curved line that resembles a rainbow. Draw a square around numbers that are the square root.

    1 2 4   1 5   1 2 4 8

7. Numbers with exactly 2 factors are **prime** numbers.

8. Numbers with more than two factors are **composite** numbers.

9. The numbers 0 and 1 are neither prime nor composite. 1 is a unique counting number. 0 is not a counting number.

Day 2

1. Before class, place the *We Are Prime (Composite) Numbers* posters in different corners of the room.

2. Before class, prepare a sheet of graph paper for each student in your class by writing a different number at the top of each sheet. Begin with the number two and continue in order until you have enough for each student (e.g., If you have 36 students in your class, you would use the numbers 2-27 for this activity.).

3. Pass out a sheet to each student. Instruct students to complete their sheets as follows:

    •   Draw all of the possible arrays for the number.

    •   Label the length and width of each array.

    •   Write multiplication sentences for each array and circle factors in red and products in blue.

    •   Draw a factor rainbow for the number.

4. As the students finish, begin sending them to different corners of the room depending on whether they have a prime or composite number. Have the students take their completed papers with them.

5. Have the students in each corner compare their numbers with other members of their group and look for things that their numbers have in common. If the students are having a difficult time seeing similarities, prompt them to look at the number of factors and arrays. Discuss the findings as a class.

6. Have one member of each group hold up the *We Are Prime (Composite) Numbers* posters.

7. Have students return to their seats and write definitions of *prime* and *composite numbers* in math journals.

8. Gather papers from students and randomly pass them out again. After looking at their new number, have students move to the correct corner of the room again. Continue to do this until all students can correctly move it either the prime or composite corners of the room.

9. If you have been hanging the *Number Posters* up around your classroom, draw students' attention to them at this time. Look at the posters and discuss how the number *one* is different than the other numbers. Write a definition for *unique number* in math journals.

Day 3

1. Show a sieve. What is it? What is it used for? How does it work?

2. We can sort numbers just like a sieve separates and sorts material.

3. Using the *Sieve of Eratosthenes*, complete the hundreds chart as follows:

   a. As a class, cross out the 1 on the chart.

   b. Putting your finger on 2 count by twos and color the top left corner of each number square yellow.

      Teacher Note: As students begin coloring, they will most likely begin to see a pattern. Explain the rule of divisibility for 2—A whole number is divisible by 2 if the ones digit is even.

   c. Put your finger on 3. Counting by threes color in the top right corner of each number square orange.

      Teacher Note: As students begin coloring, they will most likely begin to see a pattern. Explain the rule of divisibility for 3—A whole number is divisible by 3 if the sum of its digits is divisible by 3.

   d. Place centimeter cubes on all multiples of 6. Discuss patterns and divisibility for 6.

e. Put your finger on 5. Count by fives and color the bottom left corner of each number square green.
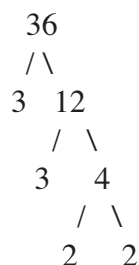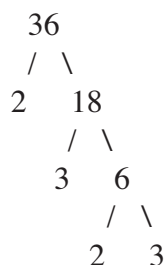
Teacher Note: As students begin coloring, they will most likely begin to see a pattern. Explain the rules of divisibility for 5 and 10—A whole number is divisible by 5 if the ones digit is 5 or 0. A whole number is divisible by 10 if the ones digit is 0.

f. Put your finger on number 7. Count by sevens and color the bottom right corner of each number square blue.

g. The boxes with nothing colored are prime numbers. Color these boxes red.

Day 4

1. How can you tell people apart? How can you tell people apart when you cannot see them? (fingerprint)

2. Just like every person has a unique fingerprint, each number has a unique "factorprint." This factorprint is the number's prime factorization. It is the set of prime numbers whose product equals the number.

Factor Trees

```
    36                36
   / \               / \
  2   18            3  12
     / \               / \
    3   6             3   4
       / \               / \
      2   3             2   2
```

Birthday Cake

Start with lowest prime number (2).
If 2 will not work, move to 3, etc...

```
        ↑
   3 | 3
   3 | 9
   2 | 18
   2 | 36
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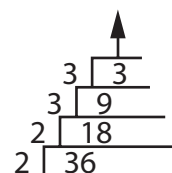
Curriculum Extensions/Adaptations/Integration

- Have students work in pairs or small groups to develop divisibility rules. Discuss as a class and complete rules as listed on p. 3-12.

- *Prove or Disprove* worksheet.

- Have students research Eratosthenes and tie to a Social Studies unit on Greece.

Resources

Book

Mathland, Journey Through Mathematics: Student Resource Book Grade 6, by Nancy Homan; ISBN 0762212411

Additional Resource

Shari Goodman, Granite School District.
  shari.goodman@granite.k12.ut.us

Family Connections

- Students explain the S*ieve of Eratosthenes* to a family member.

We Are Prime/Composite Numbers Posters

13 5 2

We Are

17

PRIME

11

7 3

Numbers 19

10 9 6 12

We Are

COMPOSITE

4 14 8

Numbers 15